

MINED LAND RECLAMATION

ANNUAL REPORT

October 1, 1977 to October 1, 1978

KENNECOTT COPPER CORPORATION
UTAH COPPER DIVISION

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In M/03502, 1978, Incoming
For additional information

Kennecott Copper Corporation

Utah Copper Division



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December 29, 1978

State of Utah
Department of Natural Resources
Division of Oil, Gas, and Mining
1588 West North Temple
Salt Lake City, Utah 84116

Attention: Mr. Cleon B. Feight, Director

Gentlemen:

Enclosed is the annual mined land reclamation report for Kennecott Copper Corporation's Utah Copper Division. This report summarizes work performed during the period October 1, 1977 to October 1, 1978 as approved on the Notice of Intention to Commence Mining Operations #Act-035-002, August 9, 1976, and subsequent surety agreement.

If you have any questions or comments about this report, please contact me.

Yours very truly,

W. D. Southard
Engineering Services Manager

WDS/ac
Enclosure

cc: Mr. R. N. Pratt, w/enc.

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ANNUAL REPORT

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UTAH COPPER DIVISION

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MINED LAND RECLAMATION ANNUAL REPORT
OCTOBER 1, 1977 TO OCTOBER 1, 1978

KENNECOTT COPPER CORPORATION
UTAH COPPER DIVISION

INTRODUCTION

The following report is submitted to the Utah State Division of Oil, Gas and Mining as prescribed under paragraph (b), Rule M-8, Utah State Mined Land Reclamation Act of 1975. The report summarizes work performed during the period October 1, 1977 to October 1, 1978 as approved on the Notice of Intention to Commence Mining Operations #Act-035-002, August 9, 1976 and subsequent surety agreement.

LOCATION OF OPERATIONS

Under the original notice the operations of the Bingham mine and concentrator were conducted in the following sections of Salt Lake and Tooele Counties:

Sec 7, 8, 9, 10, 11, 17, 18, 19, 20, 21, 30, 31 & 32, T1S, R2W, SLB&M;
Sec 9, 10, 11, 12, 13, 14, 15, 16, 22, 23, 24, 25, 26 & 36, T1S, R3W, SLB&M;
Sec 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 22, 23, 27, 28 & 33, T2S, R2W, SLB&M;
Sec 7, 8, 17, 18 & 19, T3S, R1W, SLB&M;
Sec 8, 13, 14, 15, 16, 17, 18, 19, 20, 21, 24, 25, 28, 29, 30, 31 & 32, T3S, R2W, SLB&M;
Sec 11, 12, 13, 14, 15, 21, 22, 23, 24, 25, 26, 27, 33, 34, 35 & 36, T3S, R3W, SLB&M;
Sec 6 & 7, T4S, R2W, SLB&M;
Sec 1, 2, 3, 11 & 12 T4S, R3W, SLB&M.

Disturbance of the natural terrain during the period was confined to the following sections in Salt Lake County:

Sec 18, 19, 29, 30 & 31, T3S, R2W, SLB&M;
Sec 13, 36, T3S, R3W, SLB&M;
Sec 1, T4S, R3W, SLB&M;
Sec 6, T4S, R2W, SLB&M.

SUMMARY OF MINING AND CONCENTRATOR OPERATIONS

During the reporting period, an estimated 158,687,000 short tons of material were moved at the mine. Waste material from the concentrator operations was deposited on the division's existing tailing pond. This resulted in a rise in elevation of the tailing pond of approximately four (4) feet. There was no increase in tailing areas (disturbed acreage) as a result of the concentrator operations.

Although no new acreage was disturbed in the mine area, waste disposal operations and construction disturbed an estimated 98.1 acres of previous undisturbed ground.

These areas are summarized as follows:

| | | |
|----|--|------------|
| 1. | Area disturbed by rail waste operations | 18.0 acres |
| 2. | Area disturbed by truck waste operations | 52.0 " |
| 3. | Area disturbed for shop expansion | 9.2 " |
| 4. | Area disturbed for rail yard expansion | 10.1 " |
| | Total | 89.3 " |

In addition, construction at the mine disturbed the following acreage:

| | | |
|----|--------------------------------|-----------|
| 5. | Office building construction | 2.4 acres |
| 6. | Improved rail dump access road | 6.4 " |
| | Total | 8.8 " |

The only other major disturbance in the area involved the demolition of barrack-type housing in Lark. This work was accomplished in an environmentally sound manner including regrading to approximate contours of the surrounding area and preservation of existing vegetation, where possible.

MONTHLY STATUS OF RECLAMATION WORK

TAILING POND BERM AND DIKES

| | |
|----------|---|
| Oct 1977 | Seeded and fertilized berms on 100 acres of the tailing pond. Five tons of fertilizer was used with one ton of grass seed. Fifty trees were pruned around the dike. There were 3,000 grass and shrub plugs planted that had been grown in the greenhouse. |
| Nov 1977 | Planted 5,000 shrub and grass plugs in the dike area. Pruned and fertilized trees around the dike. |
| Dec 1977 | Planted 200 wheat grass plugs on the tailing berm. |
| May 1978 | Planted 50 pounds of wheat grass on dike berm and 300 alfalfa plugs. |
| Jul 1978 | Involved in plant and shrub maintenance on the tailing dike. |
| Aug 1978 | Plant and shrub maintenance imperative because of the drought conditions. |
| Sep 1978 | Plant and shrub maintenance. |

CONCENTRATOR

Oct 1977-Oct 1978

| | |
|----------|--|
| Nov 1977 | Continued landscape beautification in concentrator area. Planted 500 flowering bulbs, hauled in topsoil and gravel. Planted 10 specimen-type trees and pruned and fertilized existing trees. |
|----------|--|

Dec 1977 Planted 200 Kochia plants, pruned trees and fertilized plants and shrubs in test area on railroad fill south of Bonneville car dumper. Also, fertilized trees at Bonneville. Planted 50 pounds of wheat grass on Magna mill landfill dump.

Jun 1978 Improved disturbed areas around Toronto cave, hand spread 20 yards of topsoil, constructed an erosion control wall and planted 50 native shrubs. Did shrub maintenance at concentrator.

Jul 1978 Maintenance work on shrubs and plants at the concentrator.

Aug 1978 Shrub, plant and tree maintenance at the concentrators.

Sep 1978 Shrub, plant and tree maintenance at the concentrators.

MINE

Oct 1977 Trees watered and fertilized at the evaporation ponds.

Nov 1977

1. Fertilized the Castro disturbed area. Seeded 50 pounds of grass seed there and planted 200 rubber rabbit brush plugs from the KCC greenhouse.
2. Fertilized and spread lime around the trees at the evaporation pond.
3. At the West Mountain area, planted 300 grass plugs from KCC greenhouse for a grass trial area on mine waste railroad fill.
4. On Copper Notch, planted 500 grass plugs (from KCC greenhouse) on 1/4 acre. Also broadcast grass seed in another 1/4 acre adjacent to grass plugs.

Dec 1977 Fertilized grass plugs at West Mountain and Copper Notch.

Feb 1978 Started demolition of old barracks in Lark.

Apr 1978

1. Planted 50 rose bushes and fertilized them and other shrubs on Castro disturbed area. (Planted roses because goats, cows and sheep had grazed other shrubs previous year.)
2. Made catch basins around trees at evaporation ponds and replaced nine destroyed trees.
3. Planted 2,400 shrubs donated by the U. S. Forest Service on Copper Notch. A one-acre site had been prepared by ripping the area with a grader. The shrubs were either containerized or bare root stock and were fertilized by a pellet placed in each hole dug for the plant. The area was mapped also.

- May 1978 Tree maintenance at the evaporation pond.
- Jun 1978
1. Tree maintenance at evaporation pond.
 2. Maintained shrubs and some landscape improvement at West Mountain.
 3. Did landscape maintenance and improvement at Yosemite truck operations office.
- Jul 1978
1. Planted 1,500 fourwing salt bush along evaporation pond dikes and planted 500 more grass plugs there. Maintained trees.
 2. Took a plant inventory on Midas dump and Copper Notch test planting areas.
- Aug 1978
1. Planted 1,000 more fourwing salt bush during August at the evaporation ponds. The lack of rain necessitated a lot of tree maintenance.
 2. Hauled lime for railroad fill plot study at West Mountain.
- Sep 1978
1. Maintained trees at the evaporation ponds. Lime was hauled to three more ponds.
 2. Broadcast seeded 50 pounds of pubescent wheat at the Castro disturbed area.

GREENHOUSE

- Oct 1977 Plant material and equipment maintenance and repair for tailing pond seeding at greenhouse.
- Nov 1977 Shrub and tree maintenance in greenhouse.
- Dec 1977 Equipment repair and maintenance at greenhouse as well as greenhouse cleanup and preparation for planting inside the greenhouse.
- Jan-Mar 1978 All work was primarily inside the greenhouse due to weather conditions. During that time, the production was 13,600 plants.
- Also during that period, species testing with seed samples from the Soil Conservation service was done. Seed germination studies were conducted in hostile soils taken from the smelter canyon. Research literature review was made to update revegetation techniques and improve reclamation work.
- Apr 1978 Maintained the shrub production inside the greenhouse and prepared planting equipment as well as moving some plants to the cold frame.

| | |
|----------|--|
| May 1978 | Maintained shrubs inside greenhouse. |
| Jun 1978 | Maintained shrubs inside greenhouse. |
| Jul 1978 | Maintained shrubs inside greenhouse. |
| Aug 1978 | Maintained shrubs inside greenhouse. |
| Sep 1978 | Maintained shrubs inside greenhouse. Set up new storage sheds for seed and fertilizer. |

Presently, the greenhouse is capable of producing a large number of plants and the type needed to rehabilitate Utah Copper Division properties. The plants are consistently high quality and available for use at the best planting time.

RECLAMATION WORK COST SUMMARY FROM OCTOBER 1, 1977 TO OCTOBER 1, 1978

| | |
|----------------------------------|--------------------|
| Material Cost | \$22,885.72 |
| Labor Cost | 49,608.00 |
| Rental and Equipment Use Cost | 14,941.00 |
| Total | <u>\$87,434.72</u> |

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Although no new acreage was disturbed in the mine area, waste disposal operations and construction disturbed an estimated 98.1 acres of previous undisturbed ground (see confidential map marked Exhibit I).

These areas are summarized as follows:

| | | | |
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| 1. | Area disturbed by rail waste operations | 18.0 | acres |
| 2. | Area disturbed by truck waste operations | 52.0 | " |
| 3. | Area disturbed for shop expansion | 9.2 | " |
| 4. | Area disturbed for rail yard expansion | 10.1 | " |
| | Total | 89.3 | " |

In addition, construction at the mine disturbed the following acreage:

| | | | |
|----|--------------------------------|-----|-------|
| 5. | Office building construction | 2.4 | acres |
| 6. | Improved rail dump access road | 6.4 | " |
| | Total | 8.8 | " |

The only other major disturbance in the area involved the demolition of barrack-type housing in Lark. This work was accomplished in an environmentally sound manner including regrading to approximate contours of the surrounding area and preservation of existing vegetation, where possible.

RECLAMATION OPERATIONS

The current status of the reclamation work that has been done by Kennecott Copper Corporation at the Utah Copper Division is included in this report. Also in this report is a background of the reclamation work done at the mine, concentrator and greenhouse up to now as well as the approach KCC-UCD has taken to solve the problems of mined land reclamation. The detailed costs for reclamation work at the mine and concentrator and greenhouse are at the end of this report. The mined land reclamation projects for 1979 will be included in another report.

PHILOSOPHY

Land reclamation in the arid west has been involved in the areas of range land, farmland and high elevation watersheds. A review of the past literature indicates that these activities have been quite successful and have provided some very good background information. The current approach to the mined land reclamation problem has been to use the past reclamation techniques with the same expected results. This approach is reasonable but one must recognize the fact that the problems of mined land reclamation are greater, the expected results may be less and that mined lands have a potential for other uses.

Brent T. Wahlquist's paper on "Developing Surface Mine Reclamation Plans" brings clearly in focus the problems and expectations one is confronted with in mined land reclamation. Some of his observations worth considering are discussed in the following paragraphs.

Some areas of mined land did not support vegetation before the mining operation began. Expecting that reclamation efforts will result in vegetation that did not exist on the lands before mining makes the cost per acre unjustifiable. Other areas have experienced spoil to the point that very little can or should be done and alternative land use should be considered.

Vegetation on reclaimed mine land may take many years to stabilize; Mr. Wahlquist suggests that it may take 30 years or more. He also says "...seeding efforts need to be oriented toward erosion prevention and spoil stabilization to prevent interim offsite hydrologic deterioration while supplying a seed source of those

species that would be expected to ultimately dominate the area. Surface manipulation to limit runoff followed by simple broadcast seeding is apt to be far more effective in the long term per dollar spent than carefully smoothing the spoil surface for mechanical seeding, hand transplanting seedlings of desired species or supplemental irrigation."

It is important to recognize that UCD has established a sound base to approach the problems of mined land reclamation--keeping in mind the limitations. Kennecott Copper Corporation is working to avoid revegetation schemes that produce short term results and long term failures.

REFERENCE

Wahlquist, Brent T., Developing surface mine reclamation plans, Mining Congress Journal, January 1976, 35-38.

BACKGROUND AND STATUS OF RECLAMATION OF TAILING POND

The UCD environmental staff has been involved with the tailing ponds since 1974. The two main areas of work are:

1. The tailing pond or basin, 100-400 acres per year.
2. The tailing pond berms or dikes, 100 acres per year.

A vegetative stabilization program of the tailing pond was begun in 1974. A series of studies, both greenhouse and plot studies, within the tailing basin were conducted with Japanese millet based on Larry Jones' thesis, "Vegetation Establishment on Iron Mine Tailing, Dam Berms and Waste Rock Dams." The seed rates, fertilizer rates, planting depths, broadcasting vs disc drilling, various methods of seed cover, and irrigation vs no irrigation on the tailings pond were studied. From these investigations it was concluded that for these tailing it was best to use a disc drill with a fertilizer box, seeding and fertilizing at the same time at a depth of 2" without covering the seed. The concepts and techniques of planting Japanese millet as a result of these studies have been very useful. This millet planting program is now on a yearly basis when sufficient area is available to plant. This past year, however, no area was available to plant.

BACKGROUND OF TAILING POND BERMS AND DIKES

The approach to reclaiming the tailing berm areas is similar to other devastated areas such as using available on site equipment to prepare the seed bed. The method to build new berms utilizes previously deposited tailing, thereby allowing skilled workmen to prepare a seed bed while building a berm.

To be successful in this program, two problems must be overcome:

- 1) getting the area seeded before it goes acid,
- 2) seeding prior to favorable growing conditions.

Seed rate: 15-20 lbs per acre

Seed mix: 25% rye, 25% clover, 25% tall wheat, 25% alfalfa

Prior seeding using these methods has been encouraging. In the future some improvements are planned.

Another problem associated with the Magna tailing ponds are the abandoned borrow pits once used for fill material in constructing the dikes and berms. There are three pits - one west of Magna, one west of the concentrator and one above the refinery. They are a source of dust during high winds and present a harsh appearance to surrounding plant facilities and the general public. To alleviate this situation trees, shrubs and grass plantings on a small scale have been initiated. The possibilities to rehabilitate these sites are very good. In the future our efforts in this area will be expanded.

Tailing water recycle program. Periodically the canals used in the tailing water return become filled with tailing silt. They are dredged out and spread over existing dikes and berms. When they dry out they become very dusty and present a traffic hazard and are also very unsightly. The UCD environmental staff has worked closely with dike personnel to stabilize the area. We have been able to establish vegetation on most of these sites where they are not redisturbed.

MONTHLY STATUS OF RECLAMATION WORK ON BERMS AND DIKES

| | |
|----------|---|
| Oct 1977 | Seeded and fertilized berms on 100 acres of the tailing pond. Five tons of fertilizer was used with one ton of grass seed. Fifty trees were pruned around the dike. There were 3,000 grass and shrub plugs planted that had been grown in the greenhouse. Thirty-six working days were involved in this project, including the site preparation work. |
| Nov 1977 | Planted 5,000 shrub and grass plugs in the dike area. Pruned and fertilized trees around the dike. Fifteen working days involved. |
| Dec 1977 | Planted 200 wheat grass plugs on the tailing berm in a day. |
| May 1978 | Planted 50 pounds of wheat grass on dike berm and 300 alfalfa plugs. This took about four days. |
| Jul 1978 | Involved in plant and shrub maintenance on the tailing dike for four days. |
| Aug 1978 | Plant and shrub maintenance imperative because of the drought conditions for four days. |
| Sep 1978 | Plant and shrub maintenance for four days. |

BACKGROUND OF CONCENTRATOR WORK

Reclamation work at the Bonneville concentrator and surrounding areas was begun in June 1973 in an area of approximately 40-50 acres. The objectives were dust control, erosion control, and landscape improvement.

Among the problems were low precipitation, extreme wind velocities, lack of parent soil underlain by hard rock in some areas covered by tailing, continued use of area by plant activities, and wildlife activity on new seedlings.

Site preparation methods. The area was graded and contoured with available plant equipment, a D-9 Caterpillar tractor. To reduce time, the Caterpillar tracks and blade were utilized to prepare the seed bed. By using the machinery in this way, the conventional agricultural methods of seed bed preparation were bypassed. In effect, two jobs were being done at once. On steep slopes the Cat tracks were left for seed catchments.

Seeding Methods

Agricultural type disk seed drill

Agricultural type tractor

Seeding depth $\frac{1}{2}$ " to 1"

Seeding rates 15-20 pounds per acre

Seed mix: 25% Rye - cereal

25% Tall wheat grass - *Agropyron elongatum*

25% Pubescent wheat

13% Ranger alfalfa

6% Crested wheat

6% Brome smooth

The above seed rate and mix is more or less standard for the concentrator area. Changes are sometimes made for seed availability.

The Bonneville concentrator area seeding has responded very well. Efforts there are now concentrated on maintenance and seeding new areas of disturbance that may occur. It is hoped in the future that some of the forage produced there can be utilized economically and its value to wildlife habitat recognized. A small number of fruit trees and shrubs have been planted near the work areas.

Other projects underway or completed in this area are:

1. Bonneville Rail System. A test plot was established in the large cut and fill south of the Bonneville car dumper. Progress to date has been good.
2. 1974-1975 seeding of the overflow discharge dams from the concentrator was completed.
3. Coal pile - work area was landscaped and fruit trees planted.
4. Magna mill - 1974 - seeding of refuse dump facing town of Magna.

5. Formal landscaping of Bravo gate entrance.
6. Tree planting, pruning maintenance over all concentrator area.

MONTHLY STATUS OF RECLAMATION WORK AT THE CONCENTRATORS

Oct 1977-Oct 1978

| | |
|----------|--|
| Nov 1977 | Continued landscape beautification in concentrator area. Planted 500 flowering bulbs, hauled in topsoil and gravel. Planted 10 specimen-type trees and pruned and fertilized existing trees during the entire month of November. |
| Dec 1977 | Planted 200 Kochia plants, pruned trees and fertilized plants and shrubs in test area on railroad fill south of Bonneville car dumper. Also, fertilized trees at Bonneville. Planted 50 pounds of wheat grass on Magna mill landfill dump. Half of the month was spent doing these projects. |
| Jun 1978 | Improved disturbed areas around Toronto cave, hand spread 20 yards of topsoil, constructed an erosion control wall and planted 50 native shrubs. Did shrub maintenance at concentrator. Almost the whole month was devoted to the project at the Toronto cave. |
| Jul 1978 | Maintenance work on shrubs and plants at the concentrator for three days. |
| Aug 1978 | Shrub, plant and tree maintenance at the concentrators for three days. |
| Sep 1978 | Shrub, plant and tree maintenance at the concentrators for four days. |

BACKGROUND OF MINE RECLAMATION PROJECTS

It was stated in the reclamation plan that it is impossible to "perform any revegetation as open pit mining progresses because the total area is continually being disturbed." On certain areas of the waste dumps where there is little or no sulfide mineralization, and the waste dumps are considered inactive, revegetation test work continues with the assistance of the U. S. Forest Service.

Four different areas at the mine have been actively engaged in revegetation activities since 1976. At that time, four different locations were seeded (See Exhibit I).

- | | |
|----------------|---|
| 1. "P" Midas | Aerial seeding on March 26, 1976, with 750 pounds of various seeds. |
| 2. "O" Midas | Two, one-acre test plots (2,500 plants) planted with bare root stock donated by the U. S. Forest Service. |
| 3. Castro Area | Shrubs and grasses were planted at the Castro disturbance area in Butterfield Canyon. |

4. Evaporation Ponds Trees planted (200) and grasses planted (400) pounds in two evaporation ponds that had 5,000 tons of lime incorporated into them. A disk seed drill was used with an agricultural-type tractor.

During 1977, the revegetation work continued and shrubs and trees maintained.

MONTHLY STATUS OF RECLAMATION WORK AT THE MINE

- Oct 1977 Trees watered and fertilized at the evaporation ponds for two days.
- Nov 1977 1. Fertilized the Castro disturbed area. Seeded 50 pounds of grass seed there and planted 200 rubber rabbit brush plugs from the KCC greenhouse. Two working days spent there.
2. Fertilized and spread lime around the trees for two days at the evaporation pond (see Evaporation pond location map).
3. At the West Mountain area (see Exhibit I), planted 300 grass plugs from KCC greenhouse for a grass trial area on mine waste railroad fill in one day.
4. On Copper Notch (see Exhibit I), spent three days planting 500 grass plugs (from KCC greenhouse) on 1/4 acre. Also broadcast grass seed in another 1/4 acre adjacent to grass plugs. Species list in Table 1.
- Dec 1977 Fertilized grass plugs at West Mountain and Copper Notch in a day.
- Feb 1978 Started demolition of old barracks in Lark.
- Apr 1978 1. Spent two days on Castro disturbed area planting 50 rose bushes and fertilizing them and other shrubs. (Planted roses because goats, cows and sheep had grazed other shrubs previous year.)
2. Made catch basins around trees at evaporation ponds and replaced nine destroyed trees. Four working days involved.
3. Planted 2,400 shrubs donated by the U. S. Forest Service on Copper Notch. A one-acre site had been prepared by ripping the area with a grader. The shrubs were either containerized or bare root stock and were fertilized by a pellet placed in each hole dug for the plant. The area was mapped also. This project took 20 days with two days assistance by three persons from the U. S. Forest Service. Different species listed by common names in Table 2.

- | | |
|----------|---|
| May 1978 | Tree maintenance for four days at the evaporation pond. |
| Jun 1978 | <ol style="list-style-type: none"> 1. Tree maintenance at evaporation pond for two days. 2. Maintained shrubs and some landscape improvement at West Mountain for four days. 3. Did landscape maintenance and improvement at Yosemite truck operations office for two days. |
| Jul 1978 | <ol style="list-style-type: none"> 1. Planted 1,500 fourwing salt bush along evaporation pond dikes and planted 500 more grass plugs there. Maintained trees. The evaporation ponds received almost daily attention during July 1978. 2. Took a plant inventory on Midas dump and Copper Notch test planting areas (see table 3 for plant inventory). |
| Aug 1978 | <ol style="list-style-type: none"> 1. Planted 1,000 more fourwing salt bush during August at the evaporation ponds. The lack of rain necessitated a lot of tree maintenance. During August, daily work was done at the evaporation ponds. 2. Hauled lime for railroad fill plot study for five days at West Mountain. |
| Sep 1978 | <ol style="list-style-type: none"> 1. Maintained trees at the evaporation ponds for four days. Lime was hauled to three more ponds. 2. Broadcast seeded 50 pounds of pubescent wheat at the Castro disturbed area for two days. |

GREENHOUSE OPERATION

Presently, the greenhouse is capable of producing the large number of plants and the type needed to rehabilitate Utah Copper Division properties. The plants are high quality consistently and available for use at the best planting time. With the "tube pack" type of containers, the transplanting show is low; therefore, the transplanting loss is very low as well.

The goals for 1978 were to develop a growing medium best suited for our type of operation and to determine the problems concerned with growing native vegetation and how to correct them, e.g. water requirements, heat requirements, light requirements, disease control, insect control, and fertilizer requirements. Early in 1978 these goals were accomplished.

GREENHOUSE LABOR DISTRIBUTION

The greenhouse operation is a flexible one. Generally, during January, February and March the reclamation staff is involved in green plant production. However, as spring approaches, one member prepares for and implements ongoing field projects while the other member is involved in plant production.

Utilizing the intense operation concept during January, February and March and hopefully producing the amount of vegetation required leaves some planting operations available, i.e. if favorable weather conditions occur, the entire staff could move into field planting.

GREENHOUSE PRODUCTION IN 1978

The greenhouse production for 1978 was done mostly from January to March 15, 1978. The number of plants and species were:

| <u>Species</u> | <u>Quantity</u> |
|---|-----------------|
| Chrysothamnus nauseosus (rubber rabbitbrush) | 1,000 |
| Antriplex canescens (fourwing saltbush) | 4,400 |
| Acer grandidentatum (big tooth maple) | 5,450 |
| Quercus gambelii (Gambel's oak) | 1,750 |
| Wild flowers (Mixed native varieties; varieties not stated. These flowers will be keyed out and identified in the spring and summer of 1979.) | 1,000 |

Seed samples were donated by the Soil Conservation Service. This species testing was done in the greenhouse. The plants were then cultivated in designated testing areas.

MONTHLY STATUS OF RECLAMATION WORK IN GREENHOUSE

| | |
|--------------|--|
| Oct 1977 | Plant material and equipment maintenance and repair for tailing pond seeding at greenhouse. |
| Nov 1977 | Shrub and tree maintenance in greenhouse. |
| Dec 1977 | Equipment repair and maintenance at greenhouse as well as greenhouse cleanup and preparation for planting inside the greenhouse. |
| Jan-Mar 1978 | All work was primarily inside the greenhouse due to weather conditions. During that time, the production was 13,600 plants. Refer to greenhouse production in 1978 for specifics. Also during that period, species testing with seed samples from the Soil Conservation service was done. Seed germination studies were conducted in hostile soils taken from the smelter canyon. Research literature review was made to update revegetation techniques and improve reclamation work. |

| | |
|----------|--|
| Apr 1978 | Maintained the shrub production inside the greenhouse and prepared planting equipment as well as moving some plants to the cold frame. |
| May 1978 | Maintained shrubs inside greenhouse. |
| Jun 1978 | Maintained shrubs inside greenhouse. |
| Jul 1978 | Maintained shrubs inside greenhouse. |
| Aug 1978 | Maintained shrubs inside greenhouse. |
| Sep 1978 | Maintained shrubs inside greenhouse. Set up new storage sheds for seed and fertilizer. |

RECLAMATION STAFF AND AGENCY ASSISTANCE

The reclamation section at Kennecott for the period from October 1977 to October 1978 consisted of three full-time employees. There are two field reclamation personnel and a reclamation supervisor to direct the activities. From June 1 to August 31, 1978, four students were hired to help maintain trees and shrubs and aid in the different planting projects.

To conduct a program such as the reclamation work and to achieve objectives given by management, requires all available talents and disciplines within the company be utilized and also requires cooperation with all outside agencies.

Company-wide participation makes objectives reachable while minimizing the problems. Within the company, the reclamation staff worked closely with:

- plant supervisors
- field supervisors
- engineers
- metallurgists, chemists
- geologists
- all other employees with particular areas of competence.

When a new program such as this is begun, a major problem which occurs is duplication of research and field application. Rather than devoting time and effort to duplication, the UCD program went directly to agencies and people who could provide assistance in furthering the program. As a result, UCD has very good working relationships with:

- Division of Wildlife Resources, land reclamation
- U. S. Forest Service
- State Board of Forestry
- State Soil Conservation Service
- U. S. Soil Conservation Service
- Utah State Extension Division, Department of Agriculture
- State Seed Lab and Utah Seed Council
- Northrup King seed research
- Private landscape firms
- Private greenhouse operators

Arboretum Guild, University of Utah
BYU Range Science, Botany Department
Private individuals in horticulture
Plant Science, Utah State University at Farmington
University students involved in botany research
University of Utah Herbarium
Walter Cottam, professor emeritus in botany
Flood control, State geologist

RESOURCES, FACILITIES AND EQUIPMENT AVAILABLE FOR
UTAH COPPER DIVISION RECLAMATION WORK

The reclamation field headquarters is located in Bacchus, Utah. To implement the various disturbed lands reclamation programs on UCD properties the following resources are available:

- 10 acres of land, Coon Canyon Ranch
- Office buildings - 2
- Storage buildings - 3
- Equipment storage garage - 2 bay
- Maintenance building - 1
- Greenhouse - 1
- Cold frame - 1
- Mixing bins - 2
- Water developments - 3
- Storage reservoir - 1
- Tree farm
- Plant field evaluation and seed park
- Helicopter with aerial seeding and fertilizer capabilities.

Additional facilities available at UCD operation areas, e.g. mine and concentrator.

Field equipment is necessary to do reclamation work. UCD owns the following equipment for reclamation use:

Field Equipment

- Pickup truck - 1
- Tractor, backhoe - 1
- Tailing pond tractor - 1
- Seed drill, agricultural type - 1
- Fertilizer spreader, agricultural type - 1
- Gas operated planting auger
- Tool bar and furrow implement
- Water pump
- Portable water lines
- Other equipment available from various operations areas within UCD
 - Caterpillar tractor with ripper
 - Motor grader
 - Watering equipment
 - Major repair capabilities - welder, machine shop, etc.

Equipment, Horticultural

- Pruning tools
- Table saw
- Chain saw
- Sprayer
- Hand seeders
- Hand fertilizer spreader
- Plant press
- Plant dryer
- Small technical items
- Various watering devices
- Tube-Paks
- Tube-Pak crates
- Tube-Pak assembler
- Picks, shovels
- Heating and cooling systems
- Biological controls

Equipment, Maintenance

- Grease guns
- Wrenches
- Drills
- Welder
- Other miscellaneous items necessary to carry our proper maintenance

Also available from State and Federal agencies is specialized seeding and technical equipment.

RECLAMATION WORK COST SUMMARY FROM OCTOBER 1, 1977 TO OCTOBER 1, 1978

| | |
|--------------------|--------------------|
| Material Cost | \$22,885.72 |
| Labor Cost | 33,186.00 |
| Rental and | |
| Equipment Use Cost | 14,941.00 |
| Total | <u>\$71,012.72</u> |

| | |
|-------------|-------------|
| With Fringe | |
| Benefits on | |
| Labor Cost | \$87,434.72 |

A detailed outline of each section of reclamation costs is included in the appendix of this report.

LABOR COSTS FOR RECLAMATION WORK

These labor costs are divided into personnel days for each area by month, direct cost and cost plus fringe benefits. These costs were directly related to reclamation work done by Utah Copper Division as approved by the mining and reclamation plan.

| <u>DATE</u> | <u>AREA</u> | <u>PERSONNEL DAYS</u> |
|-----------------------------------|--|-----------------------|
| Oct 1977 | Mine | 2 |
| | Concentrator | 36 |
| | Greenhouse | 2 |
| Nov 1977 | Mine | 8 |
| | Concentrator | 35 |
| | Greenhouse | 2 |
| Dec 1977 | Mine | 1 |
| | Concentrator | 14 |
| | Greenhouse | 6 |
| Jan 1978 | Greenhouse | 44 |
| | (this includes only activities in the greenhouse for mine and concentrator projects) | |
| Feb 1977 | Greenhouse | 42 |
| | (activities for reclamation work at mine and concentrator only) | |
| Mar 1978 | Greenhouse | 46 |
| | (activities for reclamation work at mine and concentrator only) | |
| Apr 1978 | Mine | 26 |
| | Concentrator | -- |
| | Greenhouse | 10 |
| May 1978 | Mine | 4 |
| | Concentrator | 4 |
| | Greenhouse | 6 |
| Jun 1978 (4 students hired) | Mine | 8 |
| | Concentrator | 35 |
| | Greenhouse | 10 |
| Jul 1978 | Mine | 60 |
| | Concentrator | 3 |
| | Greenhouse | -- |

| | | |
|----------|--------------|------------|
| Aug 1978 | Mine | 35 |
| | Concentrator | 3 |
| | Greenhouse | 5 |
| Sep 1978 | Mine | 6 |
| | Concentrator | 3 |
| | Greenhouse | 27 |
| | Totals | |
| | Mine | 150 |
| | Concentrator | 133 |
| | Greenhouse | 200 |
| | | <u>483</u> |

At a direct cost per day by revegetation staff:

\$62/day (average)

there is an additional \$34/day in fringe benefits, thus making it

\$96/day (average)

Note: An additional \$3,240 should be added for student work directly involved with mine, concentrator and greenhouse work.

TOTAL COSTS

| | <u>Direct</u> | <u>Direct w/Fringe Benefits</u> |
|--------------------|---------------|-----------------------------------|
| Mine | \$ 9,300 | \$14,400 |
| Concentrator | 8,246 | 12,768 |
| Greenhouse | 12,400 | 19,200 |
| Student Employment | <u>3,240</u> | <u>3,240</u> (no fringe benefits) |
| Total | \$33,186 | \$49,608 |

MATERIAL COSTS FOR RECLAMATION WORK

October 1977 - October 1978

The material costs are itemized below according to greenhouse, mine and concentrator.

| | <u>COST</u> |
|--------------------------------------|--------------------|
| <u>GREENHOUSE</u> | |
| peat moss and fertilizer | \$ 239.12 |
| shovels and buckets | 21.51 |
| tube packs (containers for planting) | 500.00 |
| stepladder | 84.95 |
| propane to heat greenhouse | 269.21 |
| seeds from Native Plants | 50.00 |
| landscape tools | 85.00 |
| assorted greenhouse supplies | 86.93 |
| sub | <u>\$ 1,336.72</u> |
| <u>MINE</u> | |
| lime | \$ 5,200.00 |
| freight of lime | 11,500.00 |
| seed for evaporator pond | 1,465.00 |
| fertilizer for evaporator pond | 480.00 |
| sub | <u>\$18,645.00</u> |
| <u>CONCENTRATOR</u> | |
| fertilizer | \$ 1,506.50 |
| various grass seeds | 1,397.50 |
| sub | <u>\$ 2,904.00</u> |
| Total | <u>\$22,885.72</u> |

OUTSIDE SERVICES, RENTALS AND EQUIPMENT USE
FOR RECLAMATION WORK

October 1977 - October 1978

The equipment used to prepare a site for seeding is listed below.

TAILING POND DIKES AND BERM

| | |
|--|----------|
| Gibbons and Reed Construction Company | |
| Site preparation - tailing pond | |
| Site preparation - tailing and sludge site | \$ 8,000 |
| Wheeler Machinery Company | |
| Caterpillar D-4 rental for seeding and site preparation | 2,750 |
| Tractor rental (agricultural type) for greenhouse | 2,166 |
| Coon Construction Company | |
| Transport storage sheds and seed drill | 900 |

MINE

| | |
|--|----------|
| Grader (4 hours) for site preparation at at Copper Notch planting | \$ 125 |
| Grader (4 shifts) for lime incorporation into the evaporation ponds | 1,000 |
| Total Equipment | \$14,941 |

TABLE 1

SPECIES LIST FOR FALL 1977
PLANTING ON COPPER NOTCH
(MINE)

| <u>SCIENTIFIC NAME</u> | <u>COMMON NAME</u> |
|-------------------------|-------------------------|
| DACTYLIS glomerata | orchard grass |
| POA compressa | Canada bluegrass |
| POA ampla | big bluegrass |
| ELYMUS cinereus | great basin wild rye |
| AGROPYRON cristatum | crested wheatgrass |
| AGROPYRON spicatum | bluebunch wheatgrass |
| AGROPYRON trichophorum | pubescent wheatgrass |
| BROMUS inermis | smooth brome |
| AGROPYRON elongatum | tall wheatgrass |
| POA pratensis | Kentucky bluegrass |
| MUHLENBERGIA asperfolia | MUHLENBERGIA asperfolia |

TABLE 2

PLANTS ON COPPER NOTCH
(Common Names)

Planted April 1978

| | |
|------------------------|---------------------|
| Rabbit Brush | Chokecherry |
| Big Sage | Nine Bark |
| Wild Rose | Nevada Ephedra |
| Russion Olive | Blue Elder |
| Ephedra (Mormon Tea) | Deseret Bitterbrush |
| Snowberry | Snowbrush |
| Sand Sage Brush | Plum Cherry |
| Stansbury Cliff Rose | Cliff Rose |
| Siberian Pea Shrub | Sweet Vetch |
| Douglas Hawthorne | Bush Penstromon |
| Peking Cotoneaster | Squaw Carpet |
| Serviceberry | Deer Bush |
| Fringed Sage | Desert True |
| Antelope Bitterbrush | Siberian Pea Shrub |
| Tatarian Honeysuckle | Buck Bush |
| Indigo Bush | Peach Bush |
| Saskatoon Serviceberry | Globe Mallow |
| Rocky Mountain Sumac | Curvistamineum |
| Squaw Apple | Erigoneum Wyeth |
| Cream Bush | |

TABLE 3

INVENTORY TABLE

Test Plots on Midas Dump

| <u>Date of Inventory</u> | <u>Limited Area</u> | <u>Unlimited Area</u> | <u>Combined</u> |
|--------------------------|---------------------|-----------------------|-----------------|
| April 1976 (planted) | 1,687 plants | 785 plants | 2,472 plants |
| July 14, 1976 | 914 (54%) | 341 (43%) | 1,255 (51%) |
| June 23, 1977 | 810 (48%) | 223 (28%) | 1,033 (42%) |
| July 25, 1978 | 723 (43%) | 156 (20%) | 879 (35%) |

Originally, the areas in both test plots were divided into irrigated and non-irrigated areas. However, none of the areas have been irrigated since April 1976.

Test Plots on Copper Notch

| <u>Date of Inventory</u> | <u>Containerized Plants</u> | <u>Bare Roots</u> | <u>Combined</u> |
|---------------------------|-----------------------------|-------------------|-----------------|
| April 12, 1978 (planted) | 1,072 plants | 1,167 plants | 2,239 plants |
| July 25, 1978 (inventory) | 858 (80%) | 551 (47%) | 1,409 (63%) |

Copper Notch Planting with Plants Donated by the U. S. Forest Service in April, 1978. Note the power auger used to dig holes for plants in very rocky environment.